

THREE NEW SPECIES OF GENUS *TEMNOTHORAX*
(HYMENOPTERA: FORMICIDAE) FROM INDIAN HIMALAYAS
WITH A REVISED KEY TO THE INDIAN SPECIES

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We describe three new species of the Myrmicinae ant genus *Temnothorax* MAYR, 1861: *Temnothorax himachalensis* sp. n., *Temnothorax kashmirensis* sp. n. and *Temnothorax microreticulatus* sp. n. from Indian Himalaya. An identification key to worker caste of known Indian species is provided.

Key words: *Temnothorax*, Formicoxenini, taxonomy, new species, key, Orientalis, Himalaya

INTRODUCTION

Temnothorax MAYR is a widely spread genus with 335 described species (BOLTON 2012) and a high number of Palaearctic unexplored taxa (SEIFERT 2006, SCHULZ *et al.* 2007). It has been revived recently as a separate genus from *Leptothorax* (BOLTON 2003, 2007). Species richness in *Temnothorax* is much lower in tropical ecosystems of South East Asia and Africa, than in the Palaearctic region (BOLTON 2007, 2012). In the latter one, hot spots of *Temnothorax* diversity were recorded from Mediterranean Europe, and we postulate the same for the mountains of Himalaya.

Earlier only a few important papers have been published about *Temnothorax* taxonomy from the Eastern Palaearctic region (RADCHENKO 2004, TERAYAMA 2009, ZHOU *et al.* 2010), and the genus is very poorly investigated for India, as no significant contributions except for a few isolated descriptions have been published. In summary 7 species and 2 subspecies have been recorded from India (BHARTI 2011). MENOZZI (1939) listed 8 *Temnothorax* taxa for the Indian Himalaya region, including 2 new species/subspecies *T. desioi* (MENOZZI), *T. desioi melanicus* (MENOZZI), and 5 taxa formerly described by FOREL (1902, 1904): *T. fultonii* (FOREL), *T. inermis* (FOREL), *T. rothneyi* (FOREL), *T. rothneyi simlensis* (FOREL), and *T. wroughtonii* (FOREL). *T. schurri* (FOREL, 1902) and *T. nordmeyeri* (SCHULZ, 1997) have been described from central and south-western India respectively. More recently SCHULZ (1997) indicated the occurrence of an additional species from subcontinental Southern India, which is the first member of tropical

lowland *Temnothorax* species. With the 3 species described in present publication, *Temnothorax* is elevated to the more spacious ant genus with 12 species known from India, but the true species number will be higher, we expected that more species are still unexplored, than now described. A key for the worker caste of the Indian Formicidae species has been provided.

MATERIALS AND METHODS

The specimens were collected by handpicking method. The examination was carried on Nikon SMZ 1500 stereo zoom microscope. For the digital images, a MP evolution digital camera was used on same microscope with subsequent use of Auto-Montage software (Syncroscopy, Division of Synoptics, Ltd.). Later, images were cleaned as per requirement with Adobe Photoshop CS5. The measurements within parenthesis are for the holotypes.

The examined material is deposited in the following collections: CAS – The California Academy of Sciences, California, USA; PCAS – Private collection Andreas Schulz, Leverkusen, Germany; PSWC – Philip S. Ward Collection, Davis, USA; PUPAC – Punjabi University Patiala Ant Collection, Patiala, India; SMNK – Staatliches Museum für Naturkunde Karlsruhe, Karlsruhe, Germany.

Morphological terminology for measurements and indices are given in millimeters and includes: HL – head length: The length of the head excluding the mandibles, measured in full face view in a straight line from the middle of the anterior clypeal margin to the middle of the posterior margin of head. HW – Head width: The maximum width of the head in full face view behind the eyes. SL – Scape length: The maximum straight line length of the scape, excluding the basal constriction or neck that occurs just distal of the condylar bulb. PW – Pronotal width: The maximum width of the pronotum, measured in dorsal view. WL – Weber's length: The length of mesosoma in profile, from the posterior margin of neck shield to the posterior margin of propodeal lobes. PSL – Propodeal spine length: The straight length of the propodeal spine in profile, from the base to the tip of the spine. FCD – Frontal carinae distance: Distance between the frontal carinae, measured in full face view, taken at the level of a transverse line where the articulatory bulb of scapes inserts in the antennal socket. EL – Eye length: The largest measurable line across the compound eye including all structurally visible ommatidia irrespective of the pigmentation status, measured in lateral view. PEW – Petiole width: Maximal measured width of petiole in dorsal view. PL – Petiole length: Maximum length of petiole, measured in dorsal view from the juncture with propodeum to the juncture with postpetiole. PH – Petiole height: The perpendicularly maximum height of the petiole, measured from the apex of the node to ventral edge of petiole. PPL – Postpetiole length: Maximum length of postpetiole, measured in dorsal view from the juncture with petiole to the juncture with gaster. GL – Gaster length: Length of the gaster in lateral view from the anterior articulation with the postpetiole to the posterior most point, excluding sting. TL – Total length: HL+WL+ PL+ PPL+GL. CI – Cephalic index: HL/HW×100. SI1 – Scape index 1: SL/HL×100. SI2 – Scape index 2: SL/HW×100. PSLI – Propodeal spine length index: PSL/HW×100.

RESULTS

Temnothorax himachalensis sp. n.

(Figs 1–3)

Holotype worker – India, Himachal Pradesh, Udaipur, 32.7350°N, 76.6643°E, 2800 m a.s.l. (above mean sea level), 19.viii.2008; Paratypes: 14 workers, same data as holotype, (deposited in PCAS, PUPAC, SMNK); 1 worker India, Jammu & Kashmir, Kargil, 34.543°N, 76.135°E, 2789 m a.s.l., 27.xii.2011, (deposited in CAS) hand collecting (coll. Irfan Gul); 3 workers India, Jammu & Kashmir, Pahalgam, 34.02°N, 75.19°E, 2190 m a.s.l., 27.vii.1978, (coll. Philip S Ward) (deposited in PCAS, PSWC, PUPAC); 4 workers, 2400–2700 m a.s.l., Daksun, 09–13.vii.1976, (coll. W. Wittmer) (deposited in SMNK, PUPAC).

Worker measurements – TL 2.35–2.79 (2.35); HL 0.62–0.69 (0.63); HW 0.52–0.60 (0.52); SL 0.48–0.52 (0.48); PW 0.37–0.43 (0.38); WL 0.63–0.88 (0.63); PL 0.20–0.24 (0.21); PH 0.17–0.21 (0.18); PPL 0.18–0.23 (0.23); GL 0.66–0.80 (0.66); PSL 0.048–0.075 (0.072); FCD 0.18–0.21 (0.21); EL 0.12–0.15 (0.14); PEW 0.13–0.16 (0.15) n = 23.

Head – Subrectangular [CI= 113–122 (121)]; in full face view, posterior margin of head straight; occipital corners indistinct, moderately round; lateral sides weakly convex; anterior clypeal margin broadly rounded; eyes large, situated about the middle on the sides of the head; mandibles triangular, the masticatory margin with 5 prominent teeth; antennae 12 segmented, scape short, falling somewhat short to reach posterior margin of head [SI1= 70–76 (76), SI2= 81–95 (95)].

Mesosoma, petiole and postpetiole – In profile, promesonotal dorsum weakly convex; mesopropodeal groove present but shallow; humeri in dorsal view rounded; propodeal spines fairly long, more or less triangular, as long as approximately 2/3 the distance between their bases [PSLI= 9–14 (14)] and as long as 1/2 the distance between their tips, in a few specimens the length is 1/2 the range of their bases; petiolar node angular at apex, longer than high with short anterior peduncle; petiolar node in profile with steep and very slightly concave anterior face and strongly angled dorsum; postpetiolar node distinctly shorter than petiolar node with rounded dorsum, wider than petiole.

Gaster – Suboval, smooth and shiny.

Sculpture – Head smooth, except for fine mashed reticulate ground sculpture and longitudinal irregular rugae on genae which run up to the front of eyes and a few rugulae between the frontal carinae directed towards occipital corners; mandibles feebly rugulose; clypeus with a few longitudinal rugae on sides; pronotum smooth except a few rugulae on anterior and lateral sides; mesonotal dorsum smooth with weak reticulation on posterior half, lateral sides microreticulated and weakly rugulose; metanotum rugulose and microreticulated all over, the sculpture more distinct on lateral sides; scattered punctuation all over; petiole and postpetiole finely microreticulated and rugulose; petiolar apex with a transverse carina; gaster smooth and shiny.

Pilosity – Body covered with suberect to erect hairs, more abundant on gaster; antennae and legs pubescent.

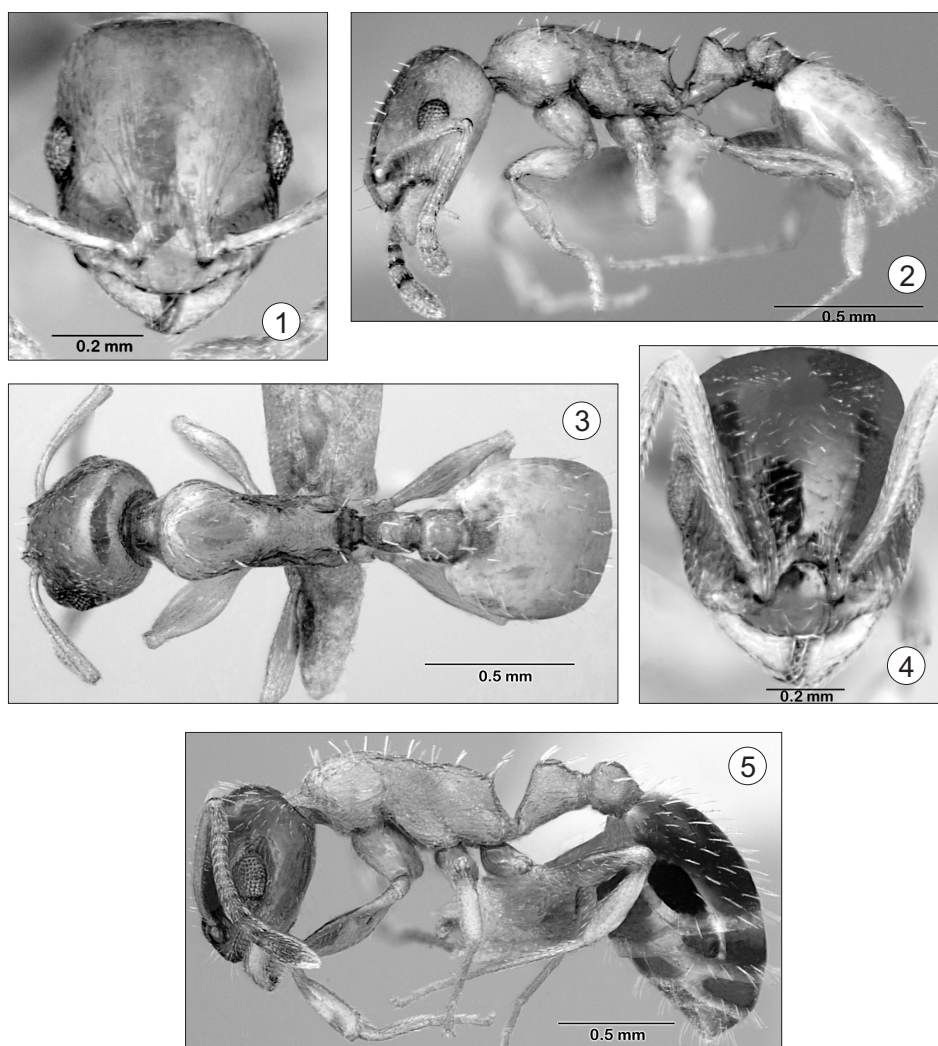
Colour – Head light yellow to dark yellow, with a brownish tinge, which varies among different specimens or nest samples; mesosoma light to dark yellow; gaster light yellow to dark yellow most often with a brownish patch dorsally in the middle; pilosity yellowish white.

Distribution and habitat – The species has been collected from different localities of Jammu & Kashmir and from a single locality of Himachal Pradesh. A single specimen from Kargil was col-

lected from sandy soil on an open hill slope sheltered by scattered vegetation. In Udaipur the specimens were collected from a mountain beside a river, nesting under a stone.

Etymology. The species is named after the type locality, Himachal.

Remarks – *Temnothorax himachalensis* sp. n. well differs from all known Himalayan *Temnothorax* species by its colour, angular petiole, smooth sculpture



Figs 1–5. *Temnothorax* workers. 1–3 = *T. himachalensis* sp. n.: 1 = head, full face view, 2 = body, lateral view, 3 = body, dorsal view; 4–5 = *T. kashmirensis* sp. n.: 4 = head, full face view, 5 = body, lateral view

and presence of metanotal groove. It most resembles *Temnothorax pallidus* COLLINGWOOD, 1961 which is also a yellow coloured species but can be easily differentiated from it by the presence of metanotal groove, longer propodeal spines, which are as long as $\frac{1}{2}$ the distance between their tips and the angular petiole which is not rectilinear when seen from above. In case of *T. pallidus* COLLINGWOOD, back of the mesosoma is without any sutural impression, propodeal spines are as long as $\frac{1}{3}$ the distance between their tips and the petiole is rectilinear when seen from above.

***Temnothorax kashmirensis* sp. n.**
(Figs 4–9)

Holotype worker – India, Kashmir, Dara, 34.187N, 74.930E, 2130 m a.s.l., 15.xii.2011 (deposited in PUPAC); Paratypes: 15 workers same data as holotype (deposited in CAS, PUPAC, SMNK); 9 workers India, Himachal Pradesh, Manali, 32.2310N, 77.1910E, 1845 m a.s.l., 17.vi.2010, hand collecting (coll. Irfan Gul) (deposited in PUPAC); 6 workers, 1 queen, Kullu Valley, vic. Kalath, 1700–1800 m a.s.l., 02.x.1996, (coll. Andreas Schulz) (deposited in PCAS, PUPAC).

Worker measurements – TL 2.5–3.3 (3.0); HL 0.63–0.72 (0.70); HW 0.51–0.58 (0.56); SL 0.47–0.56 (0.55); PW 38–43 (40); WL 0.67–0.77 (0.77); PL 0.24–0.30 (0.26); PH 0.16–0.20 (0.20); PPL 0.19–0.23 (0.23); GL 0.73–1.24 (1.02); PSL 0.080–0.16 (0.13); FCD 0.18–0.20 (0.20); EL 0.12–0.18 (0.18); PEW 0.14–0.17 (0.17) n = 31.

Head – Longer than broad [CI = 121–125 (122)]; in full face view, posterior margin of head feebly convex; occipital corners less marked than in *Temnothorax himachalensis* sp. n., moderately round; lateral sides weakly convex; anterior clypeal margin broadly rounded; eyes large, situated about the middle on the sides of the head; mandibles triangular, the masticatory margin with 5 prominent teeth; antennae 12 segmented, scape fairly long, almost reaching posterior margin of head [SI1 = 74–80 (78), SI2 = 92–99 (98)].

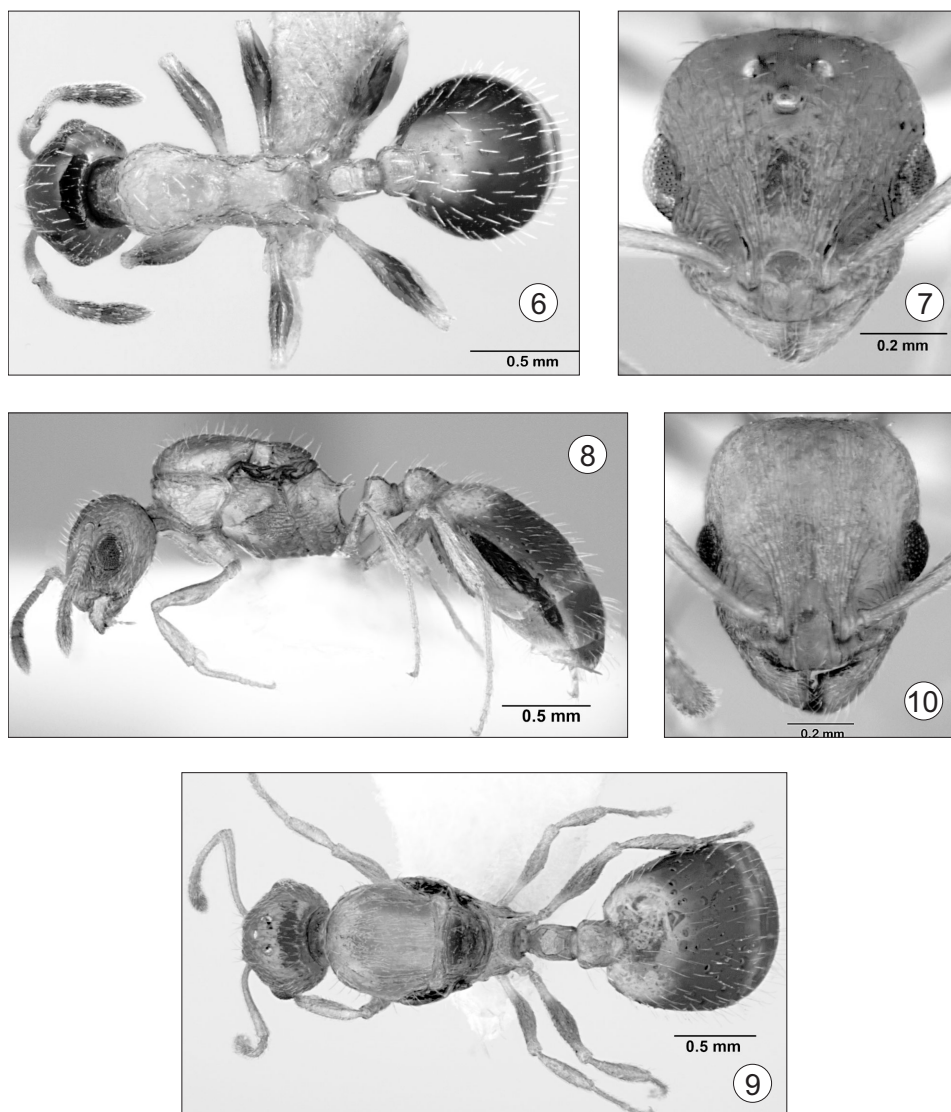
Mesosoma, petiole and postpetiole – In profile, mesosoma with weakly convex promesonotal dorsum; metanotal groove shallow, less distinct; humeri in dorsal view rounded; propodeal spines almost cylindrical, apices oblique, long, as long as what approximately is the distance between their bases [PSLI = 15–28 (23)]; petiolar node longer than high with somewhat long anterior peduncle; petiolar node in profile with steep and very slightly concave anterior face and flat to convex dorsum; postpetiolar node as high as petiole with rounded dorsum and wider than petiole.

Gaster – Ovate, smooth and shiny.

Sculpture – Head smooth, except for scattered punctures and longitudinal irregular rugae on genae which run up to the front of eyes and a few rugulae between the frontal carinae; mandibles distinct rugulose; clypeus with a few longitudinal rugae; mesosoma reticulate, rugulose, all over except for the posterodorsal part of pronotum, dorsum of mesonotum and metanotal where the sculpture is indistinct; scattered punctuation all over mesosoma; petiole and postpetiole finely microreticulated and rugulose; petiolar node dorsum circled with distinct carinae (carinae less distinct in some specimens); gaster smooth and shining.

Pilosity – Body covered with suberect to erect blunt hairs, more abundant on gaster; shorter subdecumbent hairs on antennae and legs; decumbent pubescent hairs on antennae and legs, more dense on antennal funiculus.

Colour – The species is bicoloured, with the light to dark brown head and gaster and yellowish to reddish yellow mesosoma, petiole and postpetiole; mandibles, antennae and legs yellowish to brown; pilosity yellowish white.



Figs 6–10. *Temnothorax* species. 6 = *T. kashmirensis* sp. n., worker, body, dorsal view; 7–9 = *T. kashmirensis* sp. n., queen: 7 = head, full face view, 8 = body, lateral view, 9 = body, dorsal view; 10 = *T. microreticulatus* sp. n., worker, head, full face view

Queen measurements – TL 3.46; HL 0.70; HW 0.66; SL 0.54; PW 0.64; WL 1.12; PL 0.31; PH 0.24; PPL 0.30; GL 1.03; PSL 0.12; PSLI 18; CI 106; SI1 77; SI2 81; FCD 0.21; EL 0.21; PEW 0.22 n = 1.

Resembles the worker, with modifications expected for caste and the following differences: Body massive, more hairy; head longitudinally rugose and reticulated, the rugae covering genae, antennal sockets, whole frontal area except the space in between the frontal carinae and ocelli; clypeus with a few longitudinally rugae placed wide apart; eyes large, three prominent ocelli present; mesosoma weakly longitudinally rugose on dorsum, rugulose on sides with some patches smooth; propodeal spines more or less triangular; petiole, postpetiole with a few rugulae, distinct carinae circling round the petiole dorsum; hairs of varying lengths cover entire body; mesosoma with scutellum at the same level as of the scutum; scutum with a few less distinct rugae, scutellum smooth, propodeal declivity very steep; petiolar node dorsum flat, postpetiole broad; gaster long and thick; colour slightly darker than in workers and irregular.

Distribution and habitat – The species has been collected from North-West Himalaya, in Kashmir and Himachal Pradesh. The species inhabits moderately wet and lighted coniferous forests with scarce undergrowth and nests mainly under stones.

Etymology – The species is named after the type locality, Kashmir.

Remarks – *Temnothorax kashmirensis* sp. n. is significantly different from all known Himalayan species due to following combination of characters: Head smooth; mesosoma coarsely sculptured; spines long, cylindrical, apices oblique. However, it is somewhat allied to *Temnothorax fultonii* (FOREL, 1902), which is a bicoloured species, with the head smooth without any distinct sculpture but can be easily differentiated from it by the longer propodeal spines (PSLI = 15–28) and distinct sculpture on mesosoma. In case of *Temnothorax fultonii* the propodeal spines are much shorter (PSLI = 9–11) and the mesosoma is much smoother.

***Temnothorax microreticulatus* sp. n.**

(Figs 10–15)

Holotype worker – India, Himachal Pradesh, Khajjiar, 32.545°N, 76.060°E, 2100 m a.s.l., 01.xii.2010 (deposited in PUPAC); Paratypes: 10 workers, 1 queen same data as holotype (deposited in CAS, PUPAC); 9 workers India, Himachal Pradesh, Manali, 32.2310°N, 77.1910°E, 1845 m a.s.l., 16.xi.2010. hand collecting (coll. Irfan Gul) (deposited in PCAS, PUPAC).

Worker measurements – TL 2.8–3.4 (3.3); HL 0.70–0.75 (0.74); HW 0.62–0.65 (0.64); SL 0.52–0.56 (0.55); PW 0.41–0.46 (0.45); WL 0.72–0.85 (0.85); PL 0.28–0.32 (0.32); PH 0.19–0.21 (0.21); PPL 0.26–0.29 (0.28); GL 0.88–1.2 (1.10); PSL 0.08–0.12 (0.11); FCD 0.21–0.23 (0.23); EL 0.17–0.18 (0.18); PEW 0.16–0.19 (0.19) n = 20.

Head – Subrectangular [CI= 115–117 (115)]; in full face view, posterior margin of head almost straight; narrowly round occipital corners; lateral sides subparallel, head somewhat broader posteriorly; anterior clypeal margin broadly rounded; eyes large, situated about the middle on the

sides of the head; mandibles triangular, the masticatory margin with 5 prominent teeth; antennae 12 segmented, falling somewhat short to reach posterior margin of head [SI1 = 73–75 (73.3), SI2 = 85–88 (86)].

Mesosoma, petiole and postpetiole – In profile, mesosoma with slightly convex dorsum; metanotal groove shallow; humeri in dorsal view rounded; propodeal spines short, apices oblique, as long as 2/3 the distance between their bases [PSLI = 15–18 (17.1)]; petiole longer than high with moderately long anterior peduncle; petiolar node in profile with steep and very slightly concave anterior face and feebly rounded dorsum; postpetiole shorter than petiole with rounded dorsum and wider than petiole.

Gaster – Ovate, smooth and shiny.

Sculpture – Head longitudinally rugulose between frontal carinae, the rugulae covering the frons, extending to the occiput; longitudinal irregular rugae on genae which run up to the front of eyes; rest of the head rugoreticulate; mandibles with distinct rugosity; clypeus longitudinally rugose except for the median portion; mesosoma reticulate and rugulose all over; petiole and postpetiole finely microreticulated with a few scattered rugulae; head and mesosoma with scattered punctures; gaster smooth and shining.

Pilosity – Suberect to erect hairs covering the whole body; decumbent pubescent hairs on antennae and legs, more dense on antennal funiculus.

Colour – The whole body is light to dark yellow with a reddish tinge except for the middle tergites gaster which are brown; pilosity yellowish white.

Queen measurements – TL 3.82; HL 0.77; HW 0.69; SL 0.56; PW 0.66; WL 0.83; PL 0.38; PH 0.26; PPL 0.29; GL 1.55; PSL 0.36; PSLI 52.2; CI 111; SI1 72; SI2 81; FCD 0.24; EL 0.22; PEW 0.21
n = 1.

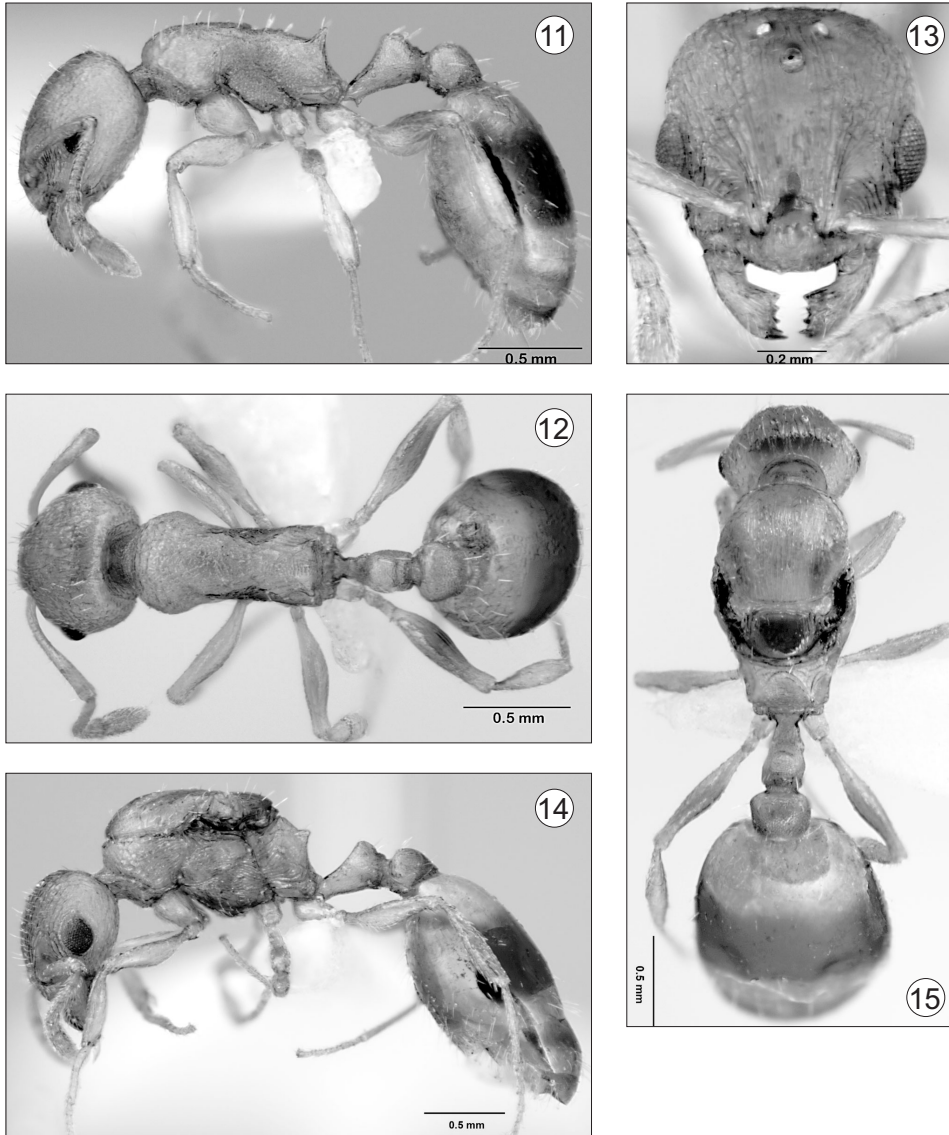
Resembles the worker, with modifications expected for caste and the following differences: Body massive, more hairy; head medially longitudinally rugose between the frontal carinae; antennal sockets and clypeus longitudinally rugose, rest of the head rugoreticulated; eyes larger, three prominent ocelli present; mesosoma weakly longitudinally rugose on dorsum, rugulose on sides with some patches smooth; propodeal spines more or less triangular; petiole, postpetiole dull due to weak sculpture on the nodes; hairs of varying lengths cover entire body; mesosoma with scutellum at the same level as of the scutum; propodeal declivity very steep; petiolar node weakly angular, postpetiole very broad; colour darker than in workers and irregular.

Distribution and habitat – The species has been collected from two localities, Manali and Khajjiar of Himachal Pradesh. The specimens were collected from soil and under stones by hand collecting. In Manali the area was forested, beside a river with good amount of moisture in the soil. It was a dense pine forest with little undergrowth. The nest was few inches deep. The other locality was a forested area with scarce undergrowth. The collection was done on a hill slope mostly covered by grasses.

Etymology – The species is named after its microreticulate sculpture on head and mesosoma.

Remarks – The species is well distinguished by the distinct sculpture of head and mesosoma compared to the rest of the Indian species. However, the species is somewhat similar to *T. nordmeyeri* SCHULZ, 1997; but it can be easily separated from it by the length of propodeal spines as in case of *T. nordmeyeri* propodeal spines are very long (PSL = 0.20–0.23 mm) while the propodeal spines are much shorter in *Temnothorax microreticulatus* sp. n. (spine length PSL = 0.09–0.11 mm).

In case of *T. nordmeyeri* the scape reaches beyond the posterior margin of head by 1/6 of its length, the colour of body is uniformly pale yellow but in *T. microreticulatus* sp. n. the scape falls somewhat short to reach posterior margin of head and the middle tergites of gaster are brown.



Figs 11–15. *Temnothorax* species. 11–12 = *T. microreticulatus* sp. n., worker: 11 = body, lateral view, 12 = body, dorsal view. 13–15 = *T. microreticulatus* sp. n., queen: 13 = head, full face view, 14 = body, lateral view, 15 = body, dorsal view

KEY TO THE KNOWN SPECIES OF *TEMNOTHORAX* FROM
INDIA BASED ON WORKER CASTE

- 1 Propodeum without any teeth or spines; pilosity very sparse; head and mesosoma shiny, very slightly longitudinally rugose, rest of the body smooth and shiny. *T. inermis* (FOREL)
- Propodeum with variously developed teeth or spines; pilosity more dense; head and mesosoma smooth or with different surface sculpture but never with only slightly longitudinally rugose sculpture. 2
- 2 Dorsal outline of mesosoma in profile without any impression, mesometanotal groove absent. 3
- Dorsal outline of mesosoma in profile more or less impressed at the mesometanotal groove or behind. 4
- 3 Mesosoma, the base of the first gastral segment, petiole, postpetiole, legs and antennae testaceous yellow to yellowish brown; head and rest of gaster brown; CI = 122–124; SI1 = 75–78.6; (length 2.2–2.9 mm). *T. desioi* (MENOZZI)
- The colour is uniformly brown; CI = 127–128; SI1 = 73–75; (length 2.4–3.0 mm). *T. desioi melanicus* (MENOZZI)
- 4 Either head and mesosoma distinctly sculptured or the head is smooth and mesosoma distinctly sculptured. 5
- Head and mesosoma smooth and shining with a few rugulae. 10
- 5 Head smooth, mesosoma distinctly sculptured; the species is bicoloured, with light to dark brown head and gaster and yellowish to reddish yellow mesosoma (length 2.5–3.3 mm). ***T. kashmirensis* sp. n.**
- Head and thorax distinctly sculptured; colour combination different but never as in above. 6
- 6 Whole body black; head distinctly longitudinally rugose; PSLI = 18–23; CI = 117–123; SI1 = 72–73; SI2 = 85–90 (length 2.8–3.2 mm). *T. schurri* (FOREL)
- Whole body light yellow to dark brown, never black; head distinctly rugulose and microreticulated. 7
- 7 The colour of head distinctly brown. 8

- The colour of head distinctly yellow. 9
- 8 Propodeal spines as long as is the interval between their bases; PSLI = 11–20; (length 2.5–3.9 mm). *T. rothneyi* (FOREL)
- Propodeal spines small, triangular, more or less dentate; PSLI = 9–10; (length 2.8–3.1 mm). *T. rothneyi simlensis* (FOREL)
- 9. Scape reaches beyond the posterior margin of head by 1/6 of its total length; the colour of body is uniformly pale yellow; propodeal spines very long (Spine length PSL = 0.20–0.23 mm). *T. nordmeyerii* (SCHULZ)
- Scape somewhat short not reaching the posterior margin of head; gaster with a brown patch in the middle; propodeal spines short (Spine length PSL = 0.09–0.11 mm); (length 2.8–3.4 mm). **T. microreticulatus** sp. n.
- 10 Propodeal spines very short, appearing as two small blunt denticles (tubercles) in dorsal view; node of petiole rounded in profile. *T. wroughtonii* (FOREL)
- Propodeal spines much longer, as long as 2/3 the range of their bases; node of petiole more or less angular in profile. 11
- 11 Head more or less chestnut brown; mesosoma, legs, antennae, petiole and post-petiole more or less yellowish brown; gaster dark brown; CI = 120–139; SI1 = 77–79; SI2 = 94–108; (length 2.4–3.1 mm). *T. fultonii* (FOREL)
- Head light yellow to dark yellow with a brownish tinge; mesosoma light to dark yellow; gaster light yellow to dark yellow most often with a brownish patch dorsally in the middle; CI = 113–122; SI1 = 70–76; SI2 = 81–95; (length 2.35–2.79 mm). **T. himachalensis** sp. n.

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